

The artists of the 20th. century inherited a Renaissance conception of space which was static. It represented the view of a single observer of the visible through the device of perspective and it separated experience into categories with neatly drawn boundaries. It was the space of common sense; the shapes of experiences were final. The work of art was as clearly marked off from its subject as it was from the spectator. The 20th century produced the crisis of this view of the world. While many people clung to the old system for security perceptive minds became aware of it only as a block; what had been sacred limits had become stultifying barriers. Their thought flowed across the old barriers, seeking correspondences in a vast new field across the barriers between visible things; between psychic and visible reality; between culture and races; between modern and primitive peoples and ways of thinking; between our star and other stars; between matter and energy; between words and sounds, colours, smells, between the work of art and nature; between the work of art and the spectator. The relativity of things was discovered simultaneously by art and science. This lecture is about movement in art; of an art of real space and real time, of real forces producing an endless transformation of expression in which the spectator could be immersed. In 1922 Maholy-Nagy formulated the following manifesto: 'We must therefore put in the place of the static principle of ~~static~~artclassical art, the dynamic principal of universal life. Stated practically; instead of static material construction, material and form reations, dynamic construction, vital construction and form relations must be ~~involved~~ evolved, in which the material is employed as the carrier of forces, carrying further the unit of construction, a dynamic constructive ~~system~~ system of force is attained whereby man, hitherto merely receptive in his observation of works of art, experiences a heightening of his own faculties, and becomes himself an active partner with the forces unfolding themselves.' A dynamic constructive system of force; suggest a structure with a more complex and dynamic kind of balance than anything in early abstract~~art~~ art. It is much more like the harmony which a living body has: the co-ordination of functions in constantly changing situations, where a body lives through its relations to things outside of it and can't be considered an isolated phenomenon. We can see this evolution as the search for a freer and more flexible language, because the work of the younger artists has already extended it. Maholy-Nagy looked forward in his imagination to an art beyond the concrete art of Mondrian and his generation. He saw that once art dropped its representational role, once its space became real; it abolished its distance, its

seperateness from the outside world and the spectator. The integration of outside nature and the spectator into the work would naturally follow, movement naturally with it. The dimension of time deprives the work of an isolated permanent existence and makes it relative. Time therefore, involves the idea of replenishment, and that the work is always new, precisely because it is always changing and lives in the present. This doesn't mean that it is ephemeral in content, in comparison with a work of the past, such as a monument, but that it is continually renewed, Like in fact, a living thing which decays and is then born again. Movement, the dimension of time, cannot be merely grafted on to an existing language, because it implies a different space. A static language is finite; it has a beginning and end; it already exists. In the work of the artists which follows, space only comes into existence during the time the work moves or is moved. The adjective 'Kinetic' has now been adopted from the designation of works of art in which the aspect of movement is dominant. In this we have to take into account whether the artist expresses the intention of laying stress on movement in his works and also whether a specific sensation of movement is passed on to the spectator. Frank Popper uses the expression 'Kinetic art' for works ranging from abstract illusionist pictures whose repetitive patterns are designed primarily to create illusory movement, to the most complex electronic three dimensional constructions which are dominated by mechanical movement. Guy Brett points out that the word 'Kinetic' has already gathered around it a lot of stylistic connotations, ~~most of them purely~~, most of them purely technical; to do with the use of mechanical systems, electric motors, light vibratory patterns and so on. However, unlike electric motors or electric lights, 'movement' is not material. It means simply that the work extends in time as well in space. It has nothing whatever to do with one material or technique more than another. Frank Malina has said that 'movement' like colour, is a fact. It is up to the artist to use motion to re-create something else. To illustrate, we have seen attempts to re-create the image of motion in the photographs of Edward Mubridge (1) and others. (2) Here we can in fact experience an idea of change, but we cannot grasp an understanding of time. Without time, the painting remains static, and the revelation of change is therefore incomplete. To come to grips with the substance of kinetic art it may be useful to divide the ~~area~~ field into three main areas: that is, kinetic works in virtual movement; three dimensional works in actual movement; and two dimensional works in actual movement. The first category must also be divided into ~~those which may be~~

~~those which have been called mobiles~~ whose movements are purely illusion-
ary and works whose virtual movement is engendered by movement of the spectator
by his active intervention of manipulation. The three dimensional works must
be divided into those which have been called mobiles and are propelled by air
currents. In addition, the question of randomness and predictability will
arise in relation to two dimensional works in actual movement, projections or
reflections ~~xxxxxxx~~ of moving forms upon screens or walls. Historically
one might find traces of concepts such as 'progress,' 'order' repetition,
and the terms of information theory in the elaboration of works of art that
stress the element of movement. References to branches of mechanics and
chemistry-dynamics, kinematics and kinetics; have found their way into art
through the practise of artist-engineers. Natural movements also provide
inspiration for the kinetic artist. The most obvious of these are those of the
elements, air, water and fire, and of related phenomena, such as flight, ~~water~~
streams and smoke. Of particular importance are the movement of the stars and
all natural cycles which involve changes of luminosity. Both Gregorio Vardanega
(3) and Frank Malina (4) owe much to this source of imagery. Technological
inventions have also exerted a discernible influence. The wheel, the watch,
the camera, are cases in point. Between the realms of art and nature, lie such
related phenomena as fireworks, smoke fountains and water displays, as well
as the feature of the urban environment in which the movements follow a pattern
entirely distinct from that of nature. The concrete references from other arts
are extremely numerous and are often cited by kinetic artists. The cinemato-
graph, music and ballet. Nicolas Schoffer and Gustav Metzger are two artists
with widely differing aims who have both set great value on the analogy with
dance. Metzger who originally viewed the action of the artist as following a
kind of choreography, now sees this feature in the controlled and related
movements of the forms themselves. Schoffer has envisaged the ~~artist~~ sculptor
as a participant in ballet. (5) Schoffer claims that sensation derived from
a static representation of present day environments, can no longer fullfil
man's seeking for new aesthetic experience. Many of Schoffer's principles
rest upon an interpretation of theories of dynamism developed by Mondrian
and his followers. (6) Gabo seems to echo Schoffer's sentiments when he says;
'Little, it seems to me, do these naturalistic artists know, how shallow their
image of reality must appear to the scientific mind of today; to the mind
which conveys to us nowadays an image of reality where there is no differences
no boundaries, between a grain of sand and a drop of water, a flash of elect-

ricity and the fragrance of a tree.' Many kinetic artists attach great value to the examples which they find in the traditions of painting and sculpture. The distinction between actual and implied movement is of profound importance. Relating to the former, ~~to the use of trompe l'oeil~~ ^{are those paintings} which has been directed to producing illusory effects on facades, in cupolas and paintings. (7) Also deriving from the abuse of linear perspective are the anamorphoses and the peculiar, accelerated and slowed down perspectives which appear especially in the 16th and 17th centuries (8) were continued as optical investigations and amusements in the 18th and 19th centuries. (9) Let us remember that earlier visionaries ~~such as Vermeer and Schott~~ produced drawings that recall to us Varsarely (11) and Bridget Riley. (12) Whilst several local Venetian and Florentine painters made illusionist paintings on blades turned toward the spectator, with the effect that the portrait of Christ turned into that of Virgin Mary as the spectator moved in front of the picture. (13) Yaacov Agam (14) has been particularly struck by Italian mannerist paintings that presented identifiable portraits when viewed from any angle. From here it is but a step to the exploitation of psycho-physiological phenomena for exclusively artistic purposes. Antecedents relevant to three dimensional works in actual movement are; hydraulic machines used for theatrical performances, used in antiquity, and the renaissance articulated statuettes, probably of Egyptian origin, mechanical toys (15) marionettes, and especially human automata, (16) very much in the fashion in the 18th century. But the object of these automata was to produce an effect of imitating natural movements, and they had no artistic role. The history of colour ~~organs~~ ^{organs} provides a close connection with the present kinetic work in two dimensions. In the 18th cent. a Jesuit, Father Castel tried to develop an ocular harpsichord, with the aim of discovering the principles of analogies between colours and musical notes. There is some doubt as to whether he made much progress but he certainly fired the imagination of his contemporaries and a whole series of colour organs, more or less successful, followed throughout the 19th century. (18) Alexander Rimington in 1893 constructed and patented a most extraordinary 'colour organ' of great sophistication. Rimington was Professor of Fine Arts at Queens College, London. Inspired apparently, by the later works of Turner, he devoted himself to an independent art of light which would be mobile and completely abstract. The organ was equipped with fourteen arc lamps whose light was projected onto a large white silk curtain. The colour (hue or dominant wavelength) of the light was controlled by means of filters varnished with aniline dyes; and it was ~~also controlled~~

also possible to regulate the two independent variables of luminosity and chroma; the one corresponding roughly to the degree of admixture of black or ~~green~~ grey in the colour, and the other, to the intensity, or degree of saturation. Luminosity was controlled with a mica diaphragm engraved with lines in a graded series which, drawn across the light source, rendered the colour successively greyer. Control over chroma was achieved by a similar grading of the varnished colour filter, which was dyed with a concentrated solution at one end and successively weaker solutions along its length, which also could be drawn across the front of the lamp. Thus Rimginton was able to achieve complete control (albeit with some inaccuracies of colour standards) over all three factors which go to define a uniquely colour sensation. An additional attachment to the colour organ produced the same effective control by means of a tri-chromatic arrangement; the light from three sources - the primaries, by addition, red, green and blue-violet, being mixed in different proportions to produce the whole range of colours. (19) ~~A modern example of a Lumidyne screen was Frank Malina.~~ Another influence for artists working with screens and projectors is the cinematograph. There are numerous examples of the same artist working simultaneously with two media. A good example is Len Lye, a New Zealander, whose films drawn directly on to celluloid led to other plastic investigations in movement, in particular to his own 'tangible motion sculpture' (20). The names of Adolph Appia and Edward Gordon Craig are particularly connected with the use of movement and light. Together with the stage techniques of dancers like Loie Fuller and Isadora Duncan and the innovations of Diaghilev, the work of these designers made its effect not only on the traditional artist, but principally those interested in movement. The technique of photography seems at first diametrically opposed to that of art in motion. Yet photography has influenced many artists who may be regarded as models of the kinetic artist. Thus a number of photographic techniques have left traces in several works of Degas; the chromophotographies of Etienne Marey, and animal and human 'locomotion' photographs of Edward Muybridge; paintings by Seurat; and more particularly, in the stroboscopic representations of the futurists. (21), (22). Balla even went so far as to introduce actual movement into a portrait and a miniature theatre. Movement in the plastic sense can be understood differently according to which plastic element it derives from. Vibration of colour, tension of line, instability of composition, interplay of light and shade, juxtaposition of textures, opposition of positive and negative volumes; all these became the concern of artists such as Kupka, Delauney,

Picabia, Duchamp, Tatlin, Kadinsky and Aronpenko. These and many more helped to liberate the element of movement by eliminating the representative content out of the work of art. But there are three trends in particular that the kinetic artist has paid attention. The dadaist, the surrealist, the constructivist, and what one might call the intellectual or spiritualist movements. Among dadaists who expressed particular interest in movement, are Picabia, Duchamp and the onetime photographer, Man Ray; one of the first to construct a suspended mobile. The constructivist trend, influenced perhaps at the outset by futurist theories of movement, was initiated by Tatlin, whose dynamic juxtaposition of surface and suspended counter reliefs (23) brought a revolutionary note into a sculpture at a time when it was being transformed by Boccioni and Duchamp-Villon. Rodchenko also brought a new vision into sculpture (24) with his suspended wooden spirals. Mondrian's balance of dynamic and static potentialities depends principally on colour (25), whilst in many of Malevitch's suprematist pictures (26) the accent is on coloured forms whirling around an axis. The use of line to create movement, perceptible in the arabesques of art nouveau (27) and Matisse (28) ~~and~~ (29) belongs to the intellectual trend. The vorticists, (30) with their quest for the energy of the spirit, find their place here, as does Kadinsky (31) who placed ^{movement} ~~movement~~ in art on a high spiritual level. In a guide to kinetic art, perhaps one general principle can be drawn as a unifying theme. That is the combination of homogeneity of surface, and instability of structure. This combination of characteristics clearly applies specifically to 'pictorial works' where the rectangular surface is dominant. But with modification it can also be applied to 'sculptural' three dimensional works (32). Instability of structure remains a factor, and, in place of the homogeneity of the two dimensional surface, we have the need to relate to a simple geometric grid. The sculpture of Schoffer (33) which originates in precisely such a grid is a clear example. The antithesis between the picture involving virtual movement and the sculpture dominated by organic or electric-magnetic forces, can therefore be re-phrased in these terms. The former depends on a balance between the repetition of anonymous forms and the appearance of peripheral structures that cannot be disturbed, since it is based on a direct physiological reactions. The latter employs actual movement and to the extent that this movement overwhelms the vestigial grid necessary to its experience, makes us aware of the powerful and suggestive implications of movement. Tinguely sculptures (34) make their strongest mark when the mechanical process appears to be wresting the structure from its anchorage, ~~and to the extent that this movement overwhelms the vestigial grid necessary to its experience, makes us aware of the powerful and suggestive implications of movement.~~

usually mechanically constant and unstable, often at the same time spectacular and embarrassingly personal. (35) For example the spectator is induced to set the work in motion by operating a pedal, but the momentum built up by the machine soon results in a cumulative rocking motion which threatens to over-balance the entire structure. The spectator withdraws his foot quickly (36) and undergoes the mild indignity of having been placed in such a situation before a casual audience. In Medalla's cloud canyons (37) the column of bubble literally spills all over the rectangular stand from which it emerges. This is a subtle and delicate effect of the natural world harnessed with so light a touch that it is not distorted. In his bubble machines, there is no structural permanence, simply the inevitable operation of a force of change - which obeys its own cycles, shifting inexplicably from expansion to quiescence. By his finely maintained balance, Varsarely ^{has as} his aim, ^{the} ~~of~~ distinguishing ^{of} the work of art from nature. (38) By threatening the balance, by declaring against the fixed, anchored element in the work of art, Takis (39) and Medalla seek to reinstate nature, to enrich our reactions by providing equivalents for growth, intercourse and decay. If the unity of kinetic art depends on the extent to which a balance is maintained between instability of structure and the grid or the homogenous surface, the range of kinetic art depends on the fact that this balance can be radically altered by the introduction of two elements - the spectator's control of transformation in the work, and the capacity of movement to dominate the fixed scheme. ~~I would like to take up a number of points which are dealt with in kinetic art and deal with them in some depth. The first is the spectator's control of transformation!~~ The following ^{video} examples will serve to illustrate some instances of spectators' participation. The first two involve works by Stein and Agam, are cases of induced movement, in which the spectator actually impels the work and ~~its~~ ^{its} changes ~~its~~ structure. In the second two, involving works by Soto and Cruxent, the spectator himself must move, but the work remains untouched. Agam's work in this field employ a combination of effects. The basic structure is a flat surface (@ 40) often circular in shape, upon which a number of detachable geometric forms are arranged. The spectator is challenged to re-arrange these forms, (41) and experiences in the process, a dialogue of hand and eye. ~~The hand detaches and replaces these elements, they are re-arranged and judged the displacements.~~ As if to redress the balance between the slow action of the hand and the quickness of the eye, Agam makes it possible to spin the entire structure (42) on its axis, so that the apparent order of the surface is dissolved in a fleeting pattern that the eye

cannot grasp. In a recent work by Stein, a revolving plate is ~~placed~~ mounted in front of a concave sheet of reflecting metal (43). The spectator places discs of different sizes, shapes and colours, on the revolving plate and watches the transmutation ~~of~~ of these juxtaposed elements, in the concave mirror. The hand is free to place any of the shapes in any order on the revolving surface, and is to this extent, in control. Yet the curved mirror introduces a virtual unpredictability into the juxtaposition of the reflected forms, distorting and amplifying them out of all recognition. To this extent the work remains outside of the control of the spectator and becomes a means of discovery. In both these works the hand plays an essential part, yet the eye remains the true focus of activity. The maintenance of a direct physiological response depends therefore on the principle that the eye should never be entirely in control of the possibilities ~~in the work~~ implicit in the work. In the works of Soto ~~and~~ and Cruzent, both of which involve the moiré effect, there is a point of rest, and consequently the pure re-action of the eye is replaced by a dialogue of eye and picture. Many of Soto's works (44) involve a background of black and white stripes, against which suspended forms (45) composed of wire, can be picked out. When the spectator moves he is aware of a rippling movement where the suspended wire and ~~stripes~~ ^{stripes} coincide. His movements therefore take on a precise significance being intimately related to the appreciation of illusory structures in the work. Cruzent employs two layers of wire mesh through which the spectator observes a decorative scheme illuminated by artificial light. His pictures come to life not in their static form not simply in their subtle optical transformations, but in the tension between the two, in the poise with which the spectator calculates his movements in order to adjust between the actual and the illusory. Because of the point of rest, in which the work by Soto or Cruzent appears static - even if the moiré effect produces overall distortions of form - the eye acquires an active role in testing the results of each change of position. I have twice referred to the moiré effect and as there is a constant reiteration of this effect in the work of certain kinetic artists, it may be as well to give some specific examples. The Oxford dictionary describes the moiré as having a clouded appearance like watered silk. R.L.Gregory in his book; 'Eye and Brain,' refers to the waterfall effect as illusions of movement due to disturbances (46) of the image/retina system. These illusions are not limited to movement of the whole visual field; various parts of the field may appear to move in different directions, and at different rates, the effects being bizarre and sometimes ~~incomprehensible~~

logically paradoxical. He continues; 'It may be induced most easily by looking steadily, for about half a minute, at the centre pivot of a rotating record player. If the turntable is then stopped suddenly it will seem, for several seconds to be rotating backwards. The same effect is found when looking at moving water, for, if the eyes are then directed ^{at} the bank, or at any fixed object, it will seem to flow in the opposite direction to the flow of water..' Later he describes; 'figures which disturb. (47) These can be quite simple; generally consist of repeated lines. The series of rays as in the fig. or the parallel lines as in the second fig. (48) have been studied recently by D.M. McKay, who suggests that the visual system is upset by the redundancy of such patterns. The point is, that given a small part of this fig., the rest can be specified by simply saying that the rest is like that which is given. McKay suggests that the visual system normally uses the redundancy of objects to save itself work in analysing information. The ray fig. (49) is such an extreme case of redundant figure that the system is upset by it. It is not entirely clear why this should happen, and one can think of other figures apparently just as redundant which do not upset the system. The ray fig. has a curious after effect, when looked at for a few seconds, wavy lines appear. These are seen for a time when the gaze is transferred to a homogenous field like a plain wall. It is a moot point whether the ray pattern produces these effects because of small eye movements shifting the repeated lines on the retina, and so sending massive signals from the 'on' and 'off' receptors. If this is the explanation, the effect may be similar to the disturbance of flickering light. However this may be, the visual system certainly is disturbed and this effect should be considered where repeated patterns are used for decoration.' It's a pity that Gregory didn't take issue with Bridget Riley's work for it would have made an interesting comparative observation alongside the comments by other psychologists, ^{who} ~~must~~ have. One of the most interesting of these is Anton Ehrenzweig who in his book; 'The Hidden Order in Art,' has this to say; 'The systematic fragmentation of the surface gestalt that characterizes the history of modern art since French impressionism, has made sure that the final space experience can never be predicted. Optical painting has made this fragmentation into a fine art. Like serial ~~music~~ music, optical painting is a case of the intellect destroying its own modes of function. The simple elements of an optical composition are serialized in so smooth a gradation that the eye fails to pick out any stable gestalt pattern. Any attempt at focussing is punished by eye twisting and an often unpleasant glare. Our vision is ~~exaggeratedly~~ ~~the~~ ~~eyes~~ ~~of~~ ~~observing~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ ~~obsessive~~ ~~and~~ ~~unpleasant~~ ~~glare~~ ~~of~~ ~~the~~ ~~optical~~ ~~painting~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ ~~obsessive~~ ~~and~~ ~~unpleasant~~ ~~glare~~ ~~of~~ ~~the~~ ~~optical~~ ~~painting~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ ~~obsessive~~ ~~and~~ ~~unpleasant~~ ~~glare~~ ~~of~~ ~~the~~ ~~optical~~ ~~painting~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ ~~obsessive~~ ~~and~~ ~~unpleasant~~ ~~glare~~ ~~of~~ ~~the~~ ~~optical~~ ~~painting~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ ~~obsessive~~ ~~and~~ ~~unpleasant~~ ~~glare~~ ~~of~~ ~~the~~ ~~optical~~ ~~painting~~ ~~and~~ ~~the~~ ~~whole~~ ~~of~~ ~~the~~ ~~work~~ ~~is~~ ~~lost~~ ~~in~~ ~~the~~ 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conditioned to give up focussing and to take up the whole picture plane in //
totality. It is at once directed to highly mobile and unstable patterns of
picture space and its fluttering pulse. In this manner the initial intellect-
ual control of optical serialization leads without transition directly to the
experience of uncontrollable pictorial space. The disassociation of intellectual
and spontaneous sensibilities that characterises so much modern art, could not
be more complete. Bridget Riley is keenly aware of these two phases in her
work. (50) She has up to a point some control over the emergent pictorial space.
There are areas of stability where the dazzle effect is minimal and which affect
ⁱⁿ
the eye, almost, but never entirely, some stable centre of attention. (51)
There the elements appear less distorted and almost detach themselves from
the continuum of the dazzle pattern. In adjacent areas the elements gradually
become absorbed into a series of imperceptible variations. At last an area of
'crisis' is reached where the element is fully submerged by a maximum dazzle
effect. The critical area (52) is also in danger of becoming isolated from
the rest of the picture plane and threatens to break the continuity of the
picture plane. Bridget Riley's conscious concern is with the gradual variation
(serialization) of the single element which represents her theme. Its effect
on the continuity of the flat picture plane and the danger of disrupting it by
isolating certain detached areas of maximum 'stability' and 'crisis' can only
be tested by trial and ~~area~~ error. When the picture plane holds without break-
ing under the opposing strains, then the final unpredictable transformation
takes place ~~towards to which she looks forward to with impatience~~. A 'presence'
comes through (53) which she likes to compare to an hallucination. A mighty
^{entire}
pulse skims through the picture plane, now lifting this or the other area to
form a fleeting and swiftly crumbling pattern which need not have any correl-
ate whatsoever in the objective composition. (54) It is this presence and not
the optically dazzling effect which matters to her. So much for the moiré,
waterfall effect. We have been considering optical movement generated by the
disturbance of the retinal image and I now want to turn to other specific means
of movement, ~~employed by artists as follows~~. The first of these is the telemagnet-
ic sculpture of Takis. ~~It is an introduction of a new element into sculpture. The~~
~~subject~~. Takis had been looking for a way to intensify the presence of energy
in his sculpture when he discovered the magnet. This provided him with an
entirely new language of space. (55) There is something of the fantastic about
Takis that refuses to allow him to be discussed in prosaic language. He has
been described by Duchamp; 'Takis is the gay labourer of magnetic fields and
indicators of gentle railways.'

A reference to Takis's signals, that signal minds not trains. On the occasion of his exhibition of telemagnetique sculpture in London on October 1964, it was the signal for an avalanche of poems dedicated to ~~him~~ His work has been variously described by the critics (56) as follows; the 'Times' 1964. Takis limits himself to essentials in the manner of the archaic greek artist. his work is not alluring, it does not evoke longing pain, perfection, pleasure or the absence of pleasure. He is inspired by a similar quality of dry flickering activity shared by the Greek lanscape, (57) and say a railway yard alive with signals and gantrys. Yet he depicts neither. In both and elsewhere, he finds instances of matter alive with energy, and the nature he explores is the same studied by scientists in terms of wave mechanics and light impulses. His forms are always effected by the air around them, and he includes forms - made or found - only in so far as they appear to receive or actually transmit impulses of energy. (58) ~~the flower is one of Takis's constant images~~ the flower is one of Takis's ~~constant images~~ most constant images. For him the flower bridges the gap between earth and sky. It is a channel for the passage of impulses drawn up from the earth and thrown into the sky as blossoms. It records energy like a seismograph, and Takis has indeed transformed the flower into a mechanism, sensing an essential similarity - first in the heavy, clean, machine forms of the early static sculptures and finally in the flickering blue blossoms of the mercury lamps. (59) His first key discovery stands out as that of magnetism. A magnet ~~throws~~ ^{throws} out a field of force around it, and it is made the active centre of a work of art, the whole drama of impulse transmission and reception is contained within the work. Solid bodies - spanners - needles, cones, (60) are held by an anchored wire a few millimetres from the magnet, with the lines of wire rushing towards it, opens up the composition over a wide area so that the full force of the magnet's presence can be felt. Around the focal point of the magnet, the flying bodies quiver and wave in the storm of unseen forces affecting them. For the first time a live force is the core of a sculpture, and the visible parts of the sculpture are subservient to that force, which is invisible. (61) A magnet and a scrap of metal floating all naked - pointing to one centre - the only centre whose balance is pure happiness of spirit.) The magnet freed Takis from the architects and engineers methods of construction, which for example Gabo used. The constructive system in a Takis sculpture is a flexible network of electro-magnet energy, not unlike a planetary system. (62a) (62b) In this work, of which Takis has made many versions, the polarities of the magnet express their duality spontaneously in dance

patterns. The principle is very simple. The upright form is an electro-magnet which swiches itself on and off regularly. When on it attracts the positive magnet in the tip of the black projectile and ~~sphere~~ repels the negative magnet in the white sphere, both are suspended from the ceiling. When the electro-magnet is off, the projectile and sphere are attracted to each other. The static upright thus splits the polarities of the mobile elements. The black element is aggressive and active, and yet sometimes centers with complete stillness to the core of the electro-magnet. The white continues a passive circulation. With the objectivity of an inventor, Takis has never ceased finding fresh sources for revealing naked energy at the core of his sculptures. He has used signal lamps, aircraft instruments, compasses, fireworks, a taut guitar wire struck by a needle bouncing in the waves of conflicting magnetic streams. In the two part sculppure (63) a blue mercury vapour lamp controls the current running to the electro-magnet. The genesis of the energy stimulating the dance of the white sphere is itself made visible as cold electric blossom in the lamp. In Takis sculpture, material is not moulded or assembled but bought into a situation where it reveals its ceaseless atomic life. The empty space between needles and magnet is the core of the sculpture, where all the tension is and there is nothing to be seen. (64) This act of revelation is enough for Takis; he has no wish to explore magnetism for dramatic effect. The sculpture presents matter-energy as a single phenomenon, and we become aware of it through all of our senses. It is impossible not to feel the force as something physical - though not tactile, because the word tactile suggests plasticity, a surface. Takis's sculpture seems to penetrate the body and orientate it more freely in space. ~~In the ground covered during the performance~~
I have given
~~many different presentations~~ only a few headings to the manifold activity of kinetic art. Major considerations, such as the articulation of space by light, the use of colour, sound, and the work of the artists who defy classification and can only be described; such as the dialogues for elastic moebius bands, a kineticism of the body by Lygia Clark, the Parangolê capes of Helio Oiticica, Mira Schendels 'droghinas' have not been touched on. The morphology of movement has certainly not been exhausted by the research which has been carried out so far. Nor have the psychological and physiological reactions of the spectator been entirely understood or explored in aesthetic terms. The combination of light and movement still seems to hold great promise for the future.

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Slides in order of appearance.

1. Edward Muybridge; 'Locomotion and Movement.' ✓
2. The knife grinder. Malevitch. ✓
3. Vardenega p.54. Kinetic Art 4 Essaya. ✓
4. Frank Malina. p.27. Lumidyne. ✓
5. Schoffer. Microtempt p.36. ✓
6. Mondrian. Colour slide. ✓
7. Trompe-l'oeil' Illusory cupola painting. Hist.Dept. ✓
8. Accelerated perspective 16-17th cent, Hist.dept. ✓
9. Optical amusements 18-19th cent. " " ✓
10. Early Visionaries. Kircher and Schott. ✗ " ✓
11. Varsarely. recall above. ✓
12. Bridget Riley. ✓
13. Venetian and Florentine painters illusionist paintings ✓ *Primo Ferruccio*
Christ and the Virgin Mary.
14. Yaacov Agam. ✓
15. Articulated toys and statuettes. Egyptian.
16. " " " " ✓
17. Human Automata of the 18th cent. *encyclopedia of world art*
18. Rimington colour organ. p.18. ✓
19. A modern example of the lumidyne. Frank Malina. p.45. (colour) ✓
20. Len Lye. ✗
21. Stroboscopic representations of the Futurists. ✓
22. " " " " ✓
23. Tatlin. Surfaces and reliefs. ✓
24. Rodchenko. Suspended wooden spirals. ✓
25. Mondrian. Colour. ✓
26. Malevitch. Similar to the knife edge grinder. Colour)
27. Arabesques of Art Neauvou. Hist.Dept ✓
28. Linear Matisse. " ✓
29. Linear Klee. " ✓
30. The Vorticists. " ✓
31. Kadinsky. Spiritual level. " ✓
32. Cover. Guy Brett. ✓
33. Schoffer tower. Cover, colour. ✓
34. Tinguely p.37 Guy Brett. ✓
35. " p.38 " ✓
36. " p.35 " ✓
37. Medalla cloud canyons p.40, 41 G.B. ✓
38. Varsarely. Mercure 2. p.63. ✓
39. Takis. Electromagnetique 2 p.60. ✓
40. Agam. Circular shape. ✓
41. " " " re-arranged. ✓
42. " " " spin. ✓
43. Stein. (Le Parc) p.52. ✓
44. Soto. p.7. ✓
45. " p.75. G.B. ✓
46. Gregory. p.105. ✓
47. " p.135 I34 (2 copies) ✓
48. " p.135. ✓
49. " Ray effect. ✓
50. Bridget Riley. Ehrenzweig. ✓
51. " " Own collection. ✓
52. Bridget Riley Own Collection. ✓
53. " " " " " ✓
54. " " " " " ✓
55. ~~Takis. Centre page. Signals~~
55. Guy Brett. p.28. ✓
56. Takis. Centre page. Signals. ✓
57. " In lanscape. " ✓
58. " Signals. ✓
59. " " Mercury lamp $\frac{1}{2}$ ✓
60. " Solid bodies, needles, span. ✓
61. " Toward a centre. Signals. ✓
62. " Magnetic ballet. G.B.P. 30?30 ✓
63. " Mercury vapour lamp. Signals ✓
64. " 2 part sculpture. Signals. ✓

Slide List: Kinetic Sculpture.

1. Muybridge 1878 Galloping horse.
2. Malevitch "The knife Grinder" 1912
3. Vardenega. Small spirals cut out of plexiglass and mounted on the surface so that they appear to float.
4. Frank Malina. Lumidyne. Colour forms painted on rotors with light source behind, on top of rotor is stator, a painted transparent perspex, light and patterns projected onto a translucent perspex screen.
5. Schoffer. "Microtemps 1" 1964 forms spin on axes intermittently and at different speeds.
6. Mondrian. 1939. Composition with red, yellow, blue.
7. Mantegna. The ceiling the ducal palace in Mantua.
8. Dutch. Perspective box.
9. Pozzo. 1691. Apotheosis of St. Ignatius. Church St. Ignatius Rome.
10. Dutch. Perspective box.
11. Praxinoscope theatre. Paris 1877. Mirrors were mounted in the centre, which reflect the pictures inside a revolving drum.
12. Mechanical vase with birds and water. Paris 1588.
13. Anamorphosis. Distorted pictures appear normal when reflected in a cylindrical, pyramidal, or conical mirror.
Top. Model of a ship. Bottom. Deformation of images.
14. Vasarely. Manipur. Denise René.
15. Vasarely. Supernova. Tate.
16. Bridget Riley. "Fall" 1963.
17. " " "Blaze" 1963.
18. " " "Disturbance" 1964.
19. Piero Della Francesca. Flagellation. Ducal Palace Urbino. 1445-80.
20. Yaacov Agam. Painting in four dimensions. 1957.
21. Squeak toys. 19th Cent. Papier Maché animals mounted on bellows with Squeaker on the bottom.
22. Sound Toys. British East India Company's Officer groaning under the claws of a tiger. Made for the amusement of Tippu, Sultan of Mysore.
23. Kites.
24. The two "Mori" Venice. 1497. St. Marks.
25. Rimington. Colour organ.
26. Malina. Lumidyne.
27. Len Lye. Vibrating rod.
28. Boccioni. 1913. Unique forms of continuity in space.
29. Balla. 1913. Dynamic expansion and velocity.
30. " " Velocity of the automobile and light clamour.
31. Tatlin. 1914. Relief.
32. " " Sculpture.
33. Rodchenko. 1920. Hanging construction.
34. Mondrian. 1921. Composition with red, yellow, and blue.
35. Malevitch. Suprematist painting. 1924. Homes for earth dwellers.
36. Art Neuvou. J. Toorop. Delft oil. 1895.
37. Matisse. 1906. Seated nude.
38. Paul Klee. 1921. Rope dancer.
39. Wyndham Lewis. 1927-8. Bagdad.
40. Kadinsky. 1922. Composition with blue triangle.
41. J.R. Soto. 1956. Spiral two perspex sheets.
42. Schoffer. Cybernetique tower.
43. Tinguely. Nevada desert. 1962. Study No. 2 for the end of the world.
44. " Pop, Hop, Op & Co. No. 22 1960-65.
45. " Rotozaza No. 1. 1967.
46. David Medalla. Bubble mobile No. 2. 1964. Cloud Canyons. Wood and foam.
47. " "
48. Vasarely. "Mercure" 1962. Colour forms which originated with Herbin.
Vasarely imposes a rectangular grid albeit slightly displaced.
49. Takis. Electromagnetique 11.
50. Yaacov Agam. Liberté. 1957.
51. Stein. Concave strips of metal create an interplay of light and shade.
52. Soto. Modulation of the blue. 1965.
53. " Striped background dematerialises the rods.
54. Gregory. When this spiral is rotated it appears to shrink or expand.
But when stopped it continues to shrink and expand in the opposite direction. This cannot be due to eye movement since the movement occurs in all directions at once.
55. The ray figure.
56. Closely spaced lines.
57. The ray figure.
58. 59. 60. 61. Bridget Riley.
63. 64. 65. 66. 67. 68. ~~Sakis~~. Takis.